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RANGE EXTENSIONS AND NOTES ON THE BIOLOGY OF FROGS FROM THE PILBARA REGION, WESTERN AUSTRALIA

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The frog fauna of the more remote parts of Western Australia is poorly known. Since the paper of Main and Calaby (1957), short papers by Ealey and Main (1960), Lindgren (1960), Calaby (1960) and Lindgren and Main (1961) have added to our knowledge of Pilbara frogs. During heavy rains in February 1961 Storr was able to make good collections and extensive field notes. At other times both authors were able to make smaller collections. However, the present

Fig. 1.—Map of the Pilbara region, showing all localities mentioned in the text.

paper consists primarily of Storr's field notes. All identifications and taxonomic notes are by Main. The present material adds considerably to our knowledge of the frog fauna of the region. Including *Pseudophryne douglasi* Main, which in the Pilbara is known only from Mt. Herbert, and *Cyclorana platycephalus* Gunther and *Neobatrachus sutor* Main, both of which have been collected at Jig-

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along but no further north, the frogs now known from the area covered in the map (Fig. 1) comprise eight genera and eleven species.

Cyclorana cultripes Parker

Distribution. *Previous records:* Woodstock and Abydos (Main and Calaby, 1957); 12 mi. E. of Port Hedland (Ealey and Main, 1960), Jigalong (Lindgren and Main, 1961). *New records:* Mundabullangana (5 mi. E., 4 mi. S. and 3 mi. S.W of homestead), Jones River (1 mi. S.E. of Warrambie HS), tributary of Turner River (18 mi. S. of Indee), Mt. Edgar (at Homestead and 3 mi. N.W., 5 mi. N. and 5 mi. W.).

Habitat. Most abundant, in association with *Lymnodynastes spenceri*, in small temporary watercourses with sandy or gravelly beds. Occasionally found in larger, wooded creeks (e.g., Jones River) and at windmills.

Morphology. Nictitating eyelid and tympanum well developed. Single spade at base of first toe. Juveniles have the hind limbs very much longer than the forelimbs and relatively larger than in adults; they are consequently adept jumpers.

Coloration in life. Only juveniles were described in the field, in the mistaken belief that they belonged to another species. Dorsal ground colour varies from golden to brassy brown. A fine vertebral line from tip of snout to coccyx, flanked on each side by a narrow, broken, greenish-black stripe. A similar stripe from the top of orbit back dorso-laterally towards the coccyx. Another and more prominent stripe from side of snout, through nostril and orbit, sweeping down and back through tympanum to ventrolateral region of trunk. This last stripe is invariably present and is especially conspicuous as a concave curve from snout to orbit; the other two pairs of stripes may be absent or represented by vague lines of blotches. Pale under, finely freckled grey on belly.

Pupil circular in daylight, with a fine extension downwards; a fine black line may run horizontally across eye (Fig. 2). Iris orange.

Voice. Loud, moderately high-pitched and rasping. Close up and in chorus, when the vibrato is clearly audible, the call sounds like an ambulance siren. At a distance it is more like the bleating of sheep.

Reproduction. At Mt. Edgar in mid-February 1961, during a wet, humid week, males were commonly found calling and copulating. On one occasion each, a male *Cyclorana* was found clasping a female *Lymnodynastes spenceri* and a male *Glauertia russelli* (itself in copula with a female of its own species!). Breeding was apparently earlier at Mundabullangana, for in the following week on that station no calls were heard and several metamorphosed juveniles were found at night.

Neobatrachus centralis (Parker)

Distribution. *Previous records:* 12 mi. E. of Port Hedland (as *Neobatrachus* sp., Ealey and Main, 1960). *New record:* Mundabullangana.

Remarks. Three specimens among the frogs collected at Mundabullangana in February 1961 are spent females with no associated field-notes. They are clearly of the same species as the two *Neobatrachus* reported by Ealey and Main (1960) but are in a better state of preservation. No males have been collected in the Pilbara, but all these females specimens are unlike *N. sutor* from Jigalong and agree with *N. centralis*.

Lymnodynastes spenceri Parker

Distribution. *Previous records:* Abydos (Main and Calaby, 1957), Jigalong (Lindgren and Main, 1961). *New records:* Mundabullangana (4 mi. S. of homestead), tributary of Turner River (18 mi. S. of Indee), Mt. Edgar (3 mi. N.W. and 5 N. of homestead).

Habitat. Small, temporary, unwooded watercourses (usually in association with *Cyclorana cultripes*).

Morphology. A short-legged frog of medium size, with a large head and truncate snout. Well-developed nictitating eyelid. Narrow spade at base of first toe. Back of male covered with minute warts. Nuptial asperities in male, the black most prominent on first finger, absent from fourth.

Coloration in life. Sexes similarly coloured, females being distinguished only by the smooth dorsum. Dorsally fawn, blotched irregularly with greenish-grey, with or without black freckling. Upper surface of limbs pale orange-brown, crossed irregularly with darker brown or greyish-green bands. Chin greenish (i.e. much the same colour as dorsal blotches), belly white, under limbs pink.

At night the pupil is large and round; in daylight it is much smaller and diamond-shaped, the longer axis vertical. Iris iridescent gold-green, minutely flecked with black.

Voice. Deep and soft, not unlike a broody hen clucking rapidly "dok, dok, dok . . ." Males were heard calling only from water and during breeding season; they were vocal by day as well as night.

Reproduction. Spawning was observed in the evening of February 11, 1961, in a small unwooded creek 3 miles north-west of Mt. Edgar homestead, where a copulating female trailed an egg mass. There were several other similar egg-masses in this stream; they were compact frothy rafts, 4-6 in. in diameter and not attached to vegetation.

Breeding was apparently finished at Mundabullangana where no calls were heard and the only specimens seen were two adults excavated on February 20 from the sandy bank of a small watercourse through open *Triodia* country.

Taxonomic notes. Moore regarded *Lymnodynastes spenceri* Parker as of doubtful validity (Moore, 1961: 195-6). However, a partly completed revision by Main (unpublished) suggests that, although the present known distributions are allopatric and there is great morphological similarity, it is more realistic to retain the two names than to lose *spenceri* in the synonomy of *ornatus*. Until a

complete revision is made it is proposed to recognise *L. speneeri* as a full species.

Notaden nichollsi Parker

Distribution. *Previous records:* No. 1 Rabbit Proof Fence (Parker, 1940), Jigalong (Lindgren, 1960), 12 mi. E. of Port Hedland (Ealey and Main, 1960). *New records:* Mundabullangana (3 mi. S.W. and 15 mi. E. of homestead), 5 mi. E. of Marble Bar, 5 mi. w. of Mt. Edgar.

Habitat. Temporarily flooded low-lying areas of tall grass, especially *Triodia pungens*. In such areas it may be associated with *Lymnodynastes ornatus* and *Cyclorana cultripes* but it does not follow the two latter species into sections of watercourses where the water is visibly flowing.

Morphology. A moderately large, stoutly built frog with a markedly truncate snout. Dorsal surface generally covered with prominent warts that tend to form longitudinal ridges. No tympanum. A single spade at base of first toe. A well-developed nictitating eyelid. Black nuptial asperities on first and second fingers of male. The copious secretion from dorsal glands rapidly becomes rubbery on exposure to air.

Coloration in life. *Adult male:* Dorsally olive green, profusely

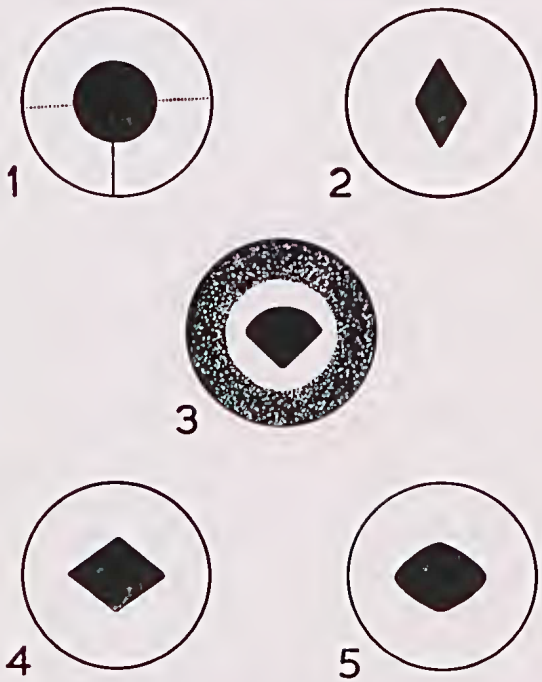

Fig. 2.—Pupil shape in daylight in (1) *Cyclorana cultripes*, (2) *Lymnodynastes speneeri*, (3) *Notaden nichollsi*, (4) *Uperoleia marmorata* and (5) *Glauertia russelli*.

spotted with reddish-orange. The warts are usually black but some are whitish, especially those towards flanks and sacrum. Under surface white, except for greyish chin. *Adult female:* differs in coloration from male only in lacking dark chin.

Pupil round at night and in shade, contracting in sunlight to a sector of a circle (Fig. 2). Iris orange adjacent to pupil, remainder black flecked with gold.

Voice. A pigeon-like "oo-oop," rising slightly but generally of medium pitch, quite musical and slightly reminiscent of *Helcioporus eyrei*. The call is relatively soft but audible for considerable distances, e.g. further than the call of *Lymnodynastes spenceri*.

When handled the frogs utter soft chirruping notes while inflating the body and greatly distending the throat.

Reproduction. Like *Cyclorana cultripes*, the present species apparently bred earlier in 1961 at Mundabullangana than at Mt. Edgar. On the former station no calling was heard in late February and young frogs (c. 1 cm. long) swarmed under the overhanging leaves of *Triodia pungens* growing beside a flooded strip of the highway. Adults, however, were still active; great numbers of them were out every night feeding over the lower-lying parts of the coastal plain.

Uperoleia marmorata Gray

Distribution. Mundabullangana (3 mi. E. and 3 mi. S.W. of homestead).

Habitat. First discovered, 3 miles east of Mundabullangana, chorusing on February 19, 1961, in a muddy pool of shallow, still, temporary water vegetated with an aquatic grass *(Dichanthium ewartianum)*, a sedge *(Cyperus bulbosus)* and nardoo *(Marsilea hirsuta)*. Such sloughs are common in this low-lying area (the floodplain between the Yule and Little Yule Rivers); they retain their water considerably longer than most temporary watercourses of the North-west and are inhabited by the tortoise, *Chelodina steindachneri*.

This species was also heard, but not collected, 3 miles southwest of Mundabullangana on February 26 in a temporarily inundated section of the highway. The country here was dominated by "spinifex" *(Triodia pungens)*. This water was shared with *Glauertia russelli* which, judging from the number of chorusing males, was the more plentiful.

Morphology. A small frog, reminiscent of *Glauertia russelli*, from which it is easily distinguished by its reddish groin, and by its head and anterior dorsum being slightly warty. No tympanum. Nictitating eyelid only occasionally raised. Two spades at base of foot. No nuptial asperities.

Coloration in life (based on a calling male, the only specimen collected). Dorsal ground colour olive-brown with black spots and blotches. Anteriorly an indistinct vertebral series of orange spots.

Dorso-laterally a broken orange stripe from behind orbit nearly to groin. A small orange spot on each side of sacrum. A large orange-red blotch in groin and on outer surface of thigh. Upper surface of limbs as on dorsum. Ventrally whitish flecked with grey. Lower surface of limbs flesh-coloured.

Pupil diamond-shaped in daylight, the horizontal axis slightly longer. Iris golden yellow, becoming black flecked with yellow distant from the pupil.

Voice. The call sounds like pebbles being sharply tapped together. The males call from tussocks of grass and are difficult to locate.

Taxonomic notes. Specimens formerly believed to belong to this species are now placed in *Pseudophryne douglasi* Main (1964). However, the above specimen from Mundabullangana undoubtedly belongs to this species. It has been compared with notes made on the type in the British Museum and with the descriptions in Moore (1961). The agreement is close except that it lacks the large parotoid glands of the holotype, the foramen appears not to be completely closed (specimen is ♂, 24.3 mm. long) and the call recorded by Storr differs from that recorded by Moore (1961: 211).

Glauertia russelli Loveridge

Distribution. *Previous records:* Weeli Wolli (Main and Calaby, 1957). *New records:* 3 mi. S.W. of Mundabullangana, 3 mi. N.E. of Mt. Herbert, tributary of Turner River (18 mi. S. of Indee), Mt. Edgar (near homestead and 5 mi. N.), Nullagine River (25 mi. E. of Mt. Edgar).

Habitat. In the vicinity of Mt. Edgar the species was restricted not only to the larger tributaries of the Talga River but also to sections of the streams that supported a forest of river gums and eajuputs. This habitat was shared with *Hyla rubella*. Wherever the gradient of a stream was steep enough to produce rapids, *Glauertia* (and indeed all other frogs) were absent.

The specimens from the Nullagine River and Mt. Herbert occupied a generally similar habitat, though the creeks at the foot of Mt. Herbert were rather steep.

At Mundabullangana the species was found in a very different habitat, viz., a temporarily inundated section of the highway across treeless plains dominated by *Triodia pungens* (here they were associated with *Notaden nichollsi, Uperoleia marmorata* and *Cyclorana cultripes).*

Morphology. A small, short-legged species with a small head and eye and a pointed, slightly upturned snout. Three pairs of raised glandular areas on back: the first and largest on the shoulders, the others lumbar and sacral. Nictitating eyelid present. Two weak spades on pes. No nuptial asperities in male.

Coloration in life. Male coloration is variable and two specimens are described:

(i) Dorsally greyish-green, spotted with blackish-green, except for the glandular areas which are yellowish-brown. Vertebral line of

dots and dashes orange at the level of forelimbs, bceoming yellow posteriorly. Small orange spots form a line between angle of mouth and axilla. Under surfaee pink and grey.

(ii) Mueh darker than (i), the dorsal ground colour being dark greenish-grey with irregularly distributed smaller spots of a darker shade. Only has a trace of vertebral line. Colour of glands as in (i).

Femalc eoloration is generally similar, i.e., dorsally greyish-green spotted and blotehed with darker greyish-green. The glands, however, are not differently coloured from rest of dorsum. The orange dots between gape and axilla may be larger than in males.

At night the pupil is round; in daylight it is diamond-shaped, the horizontal axis, if anything, longer. Iris reddish-gold immediately around the pupil, remainder greenish-black finely fleeked with gold.

Voice. Generally reminiscent of certain *Crinia* spp. Normally it is a moderately high-pitched, abrupt, slightly vibrant "ahk." Under scrutiny and possibly due to alarm, the frog may call a softer, higher-pitched and mcre rapidly uttered "ik." The gular sac is distended during ealling, which begins soon after sunset (it was never heard in daytime).

At Mt. Edgar in mid-February 1961, ealling malcs were mostly perched on a piece of debris (usually a eajuput twig) beside water. A few were half buried in mud under leaf litter, and one was found on the ground beside water, eompletely eoncealed by a flake of eajuput bark.

This frog apparently ealls outside the breeding season. Males near Mt. Herbert ealled throughout the early evening of May 20, 1961. Air and water temperatures were unusually high (77-74° F.) for that season. Just before its eessation at about 9 p.m. the eall had beeome feeble, deeply pitehed and slowly repeated.

Reproduction. In mid-February females at Mt. Edgar were gravid. Fertilization was not observed, though several pairs were found in copula either in shallow, slowly-flowing water or on nearby banks of silt. Two eopulating pairs were observed on the evening of February 17, 1961, 18 miles south of Indee; a female was hopping across a silt bank with a male mounted on her baek; the others were copulating in shallow, moving water.

Hibernation. In May 1961 speeimens were collected in daytime from under debris beside a small pool in the Nullagine River. In August of the same year two *Glauertia* (and many *Hyla rubella*) were found in damp gritty soil under small boulders beside rapidly-shrinking pools in a gully at the foot of Mt. Herbert.

Taxonomic notes. *Glauertia russelli* is distinguished from *G. mjobergi* (Andersson) of West Kimberley by the absence of maxillary teeth, absenee of tarsal tubercle, more extensive webbing of foot, granular skin of belly, and the more warty, less bright dorsal coloration.

Among the present series are three from Mundabullangana, which in texture and eolour of dorsum and reduction of webbing

between toes, tend towards the condition of *mjobergi*. Moreover, the habitat of the Mundabullangana frogs is more like that of *mjobergi* as observed by Main near Derby.

All the present series were compared with two specimens of *mjobergi* from 14 miles south of Derby, from which they are recognisably distinct. Storr noted no differences in male call between Mt. Edgar and Mundabullangana frogs, and we presume that all the present specimens belong to the same biological species. However, more extensive field biology and larger series of specimens are needed to establish the status of *G. russelli* and *G. mjobergi*.

Hyla rubella Gray

Distribution. *Previous records:* Woodstock, Wittenoom, Oakover and Rudall Rivers and Caramulla Creek (Main and Calaby, 1957); Jigalong (Lindgren and Main, 1961). *New records:* Mundabullangana (at homestead and 4 mi. S. and 15 mi. E.), tributary of Turner River (18 mi. S. of Indee), Mt. Herbert, Millstream, 9 mi. W. of Tambrey, Yampire Gorge, Dales Gorge, 7 mi. S.E. of Roy Hill, Mt. Edgar (at homestead and 5 mi. W.), Nullagine River (25 mi. E. of Mt. Edgar).

Habitat. Occurs naturally in large wooded creeks, especially those with permanent pools. Now abundant in man-made sites, e.g. wells, water tanks and troughs, and round homesteads. At Mt. Edgar and Mundabullangana the frogs were commonly found in household taps, to which they quickly return when flushed out. During wet weather they desert these artificial situations.

An adult snake *(Demansia psammophis)* killed in the late afternoon at Mt. Edgar homestead in August 1960 contained four of these frogs.

Morphology. A small, smooth-skinned frog, relatively stouter than *H. adelaidensis*.

Voice. Their call is prolonged, harsh, vibrant, and very loud, though not so ear-splitting as in *H. adelaidensis*. As observed by other naturalists the chorus is remarkably similar to that of the Silver Gull *(Larus novaehollandiae)*. The frogs call out of the water, either from the ground or a low perch. The species is vocal outside the breeding season, e.g., a strong chorus was heard on several evenings at a mill on Mundabullangana during hot dry weather in early November, 1961.

Reproduction. Tadpoles were found in a trough at a mill on Mt. Edgar in mid-February 1961 and in a clear spring-filled pool at Yampire in late February 1962. Some at least of them leave the water before metamorphosis is complete; several of the froglets clinging to the wall of a tank on Mundabullangana in February 1962 had tails up to 1 cm. long.

Hibernation. In the presence of water the frogs seem to be active throughout the year. Elsewhere they are compelled to hide. For example, on the evening of May 19, 1961, two were found in shallow

water near the edge of a lagoon on the flood-plain of the Fortescue River, 7 miles south-east of Roy Hill. On the following evening near Mt. Herbert no frogs were seen out, but many were found under rubbish; they were greatly swollen with water, which squirted from the cloaca as they sluggishly hopped away from their hiding place. Three months later at the same locality the frogs could only be found in damp gritty soil under boulders in a dry watercourse.

Hyla caerulea Shaw in White

Distribution. *Previous record:* Nickol Bay (Moore, 1961). *New record:* 3 mi. S.W. of Mundabullangana (? sp.).

Remarks. The inclusion of this large green *Hyla* rests solely on a specimen in the British Museum, labelled as coming from Nickol Bay. As this locality has been applied by the British Museum to specimens of other animals which almost certainly do not occur there, e.g., the lizard *Chlamydosaurus kingii*, the occurrence of the present frog in the Pilbara region requires confirmation. Nevertheless, *caerulea* may reasonably be expected here, for it is a Torresian species that extends from the far north and east coast of Australia far into the arid interior, including Central Australia (see map in Moore, 1961: 260).

Near the muddy pool (frequently mentioned in this paper) on the highway, 3 miles south-west of Mundabullangana, a strange frog call was heard on the evening of February 26, 1961; it was described as "grinding." Much time was fruitlessly spent in attempting to locate calling frogs, of which there were about a dozen among big clumps of *Triodia pungens* beside the water. In the water itself, "a large green tadpole, about one inch long" was reported by a colleague, R. M. Sadleir; it likewise evaded capture. It is possible that both the calling frogs and the tadpole belonged to this species. Moore describes the call of *Hyla caerulea* as a slow "crawk, crawk, crawk," and the tadpole as green.

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